

Application Serial No. 09/994,284  
Reply to Office Action of October 20, 2004

PATENT  
Docket: CU-2636

### REMARKS/ARGUMENTS

Reconsideration is respectfully requested.

Claims 1-3, 5-6, and 8-9 are pending in the present application before this amendment. By the present amendment, Claim 1 has been amended. No new matter has been added.

Claims 1-3, 5-6, and 8-9 stand rejected under 35 U.S.C. § 103(a) as being obvious over Applicants' admitted prior art (APA) in view of U.S. Patent No. 5,356,833 (Maniar). The "et al." suffix, which may appear after a reference name, is omitted in this paper.

Applicants respectfully point to APA page 5, lines 13-19. One of the problems of conventional CMP process is that "A general CMP process **completely planarizes** an entire surface regardless of the field and active areas h and the along a dotted line AA' [with reference to FIG. 2]."

Applicants are not simply claiming a CMP process utilizing novel parameters relating to ph, selection ratio, etc.

The core of the Applicants' invention (among other novel features disclosed and taught in the Specification) goes to a unique method of fabricating metal gates in a semiconductor device utilizing a novel method of non-linear planarization of the device as shown in FIGS. 3C-3D that polishes away the top portions of the insulating layer 26 and the mask patterns 24a (formed at different heights), **not** in the manner of the prior art that would completely planarize the surface regardless of the height difference between different dummy gates (23, 24a, 25, with or without 22).

Instead, the present application teaches a novel method of non-linear

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planarization of the device surface that would **not** indiscriminately cut away in a straight line the top portions of dummy gates of greater height as shown in FIG. 2, along AA'.

Applicants respectfully assert that, according to APA, a "complete planarization" or a linear planarization is **what is known to and generally understood by** those who are skilled in the pertinent art with respect to a CMP process.

This general understanding about the prior art condition of a conventional CMP process has **not** been contradicted by Maniar. Nowhere in Maniar teaches a non-linear planarization by a CMP process. Maniar merely discloses a known and conventional slurry material that is based on  $\text{CeO}_2$ . In addition, Maniar teaches a linear planarization by a CMP process utilizing a known slurry such as that containing  $\text{CeO}_2$  (see col. 5, lines 53-63)

More specifically, Maniar in col. 5, lines 52-54 specifically teaches 1:1 selectivity when performing CMP. This teaches away from the teachings of the present application. The selection ratio the insulating interlayer and the dummy gate polysilicon layer is over 20 according to the presently claimed invention. This contributes to the wave-like profile of the polished surface. Therefore, Maniar **teaches away** from the presently claimed invention, and even if Maniar is combined with APA, the presently claimed invention is not taught or suggested.

Maniar col. 5, line 59 discloses that  $\text{CeO}_2$  as one of the possible slurries that can be used for CMP processes on the " $\text{AB}_3$ " layers, but this appears to be the extent of the Maniar's disclosure.

Applicants have already admitted that  $\text{CeO}_2$  is a known slurry material for CMP process. Applicants are not simply claiming applying  $\text{CeO}_2$  as a slurry for CMP as this

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is already known in Maniar.

The key issue is whether Maniar teaches a non-linear planarization in a CMP process, regardless of whether or not Maniar discloses a CeO<sub>2</sub> based slurry is used in a CMP process.

Maniar teaches the linear planarization and teaches away from the non-linear planarization in a CMP process. Maniar col. 5, lines 52-55 teaches that the selectivity ration is "as close to 1:1". This teaches away from the non-linear planarization as taught in the presently claimed invention, which requires the selectivity ration of at least 20.

APA page 5, lines 13-20 and FIG. 2 makes it very clear that "A general CMP process completely planarizes an entire surface regardless of the field and active areas ... along a dotted line A-A'." In my view, this should sum up the state of the prior art before the present invention. Therefore, APA fails to provide and teachings or suggestions of non-linear CMP process.

Therefore, even if the teachings of Maniar and APA are combined, the claimed step of --performing a non-linear planarization-- is not taught or suggested by these references.

Applicants respectfully assert again that, according to APA, a "complete planarization" or a linear planarization is **what is known to and generally understood** by those who are skilled in the pertinent art with respect to a CMP process prior to the present invention. As explained above, this has not been contradicted by Maniar.

APA page 5, lines 13-15 clearly discloses the state of the prior art known by Applicants prior to the present invention:

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"A general CMP **completely planarizes** an entire surface regardless of the field and active areas h and the along a dotted line AA'."

This known state of the prior art is not contradicted in anyway by the teachings of Maniar. To the contrary, Maniar supports and corroborates this conclusion of the prior art as Maniar teaches that the selectivity ratio should be as "close to 1:1" (by using one of known slurries, one of which happens to contain  $\text{CeO}_2$ ).

Therefore, the Examiner makes an **incorrect** conclusion in the Office Action, page 4, bottom that:

"it would have been obvious to one of ordinary skill in the art at the time the invention was made to apply the known  $\text{CeO}_2$  as the slurry in the known CMP process in the structure of applicants' admitted prior art as  $\text{CeO}_2$  would be selected *in accordance with the variation of the topologies structure in the applicant's admitted prior art.*"

As discussed above, Maniar teaches conventional CMP process that performs linear planarization as this teaching of Maniar is corroborated by its teachings that selection ratio is 1:1 and in the embodiment of FIG. 10. Nowhere in Maniar, it is taught that its CMP process is used for non-planarization. Maniar affirmatively teaches linear planarization as the selection ratio is 1:1 and in the embodiment of FIG. 10.

Whether or not Maniar teaches the  $\text{CeO}_2$  based slurry when performing the CMP process, without the teachings learned from the present application, Applicants respectfully question how anyone can be motivated to perform a non-linear planarization of the claimed invention. Thus, the obviousness rejection in the Office Action improperly relies on the impermissible hindsight reasoning, because the rejection would not be obvious absent the Applicants' disclosure about the non-linear planarization in this application (see 37 C.F.R. §1.104(c)(2)).

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Hindsight reasoning is not permitted. The Office Action provides a conclusive statement of obviousness to the effect that one of ordinary skilled art would be motivated to apply the CMP process taught in Maniar to the APA and allegedly produce the results of the presently claimed invention. However, it is respectfully submitted that such a conclusive statement of obviousness is based on an impermissible presumption. The basis for improperly finding the presently claimed invention obvious appears to be the teaching found in the present application, and not in the prior art.

In view of the arguments above, an Official Notice seems to have been taken by the Office Action, page 4, bottom that:

"it would have been obvious to one of ordinary skill in the art at the time the invention was made to apply the known  $\text{CeO}_2$  as the slurry in the known CMP process in the structure of applicants' admitted prior art as  $\text{CeO}_2$  would be selected *in accordance with the variation of the topologies structure in the applicant's admitted prior art.*"

Applicants respectfully assert for the third time that, according to APA, a "complete planarization" or a linear planarization is **what is known to and generally understood by** those who are skilled in the pertinent art with respect to a CMP process prior to the present invention. As explained above, this has not been contradicted by Maniar.

According to MPEP §2144.04C:

"If applicant adequately traverses the examiner's assertion of official notice, the examiner must provide documentary evidence in the next Office action if the rejection is to be maintained. See 37 CFR 1.104(c)(2)."

Applicants respectfully request a proof of evidence that the claimed technique of **non-planarization by utilizing a CMP process** is known by the those of ordinary skill

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in the pertinent art—especially on a structure that includes, inter alia, a layer having a selection ratio of over 20. For example, APA's insulation layer 7 and the gate metal layer 9 would not provide a high selection ratio that will facilitate the non-planarization during a CMP process. That is, the polish selection ration of 20 between is achieved between layers 23 and 26 of FIG. 3D by reducing pressure and increasing RPM of the support table as supported in the Specification page 12, lines 5-9, whereas this is not achieved in FIG. 2

The non-linear planarization of the present invention is shown in an embodiment according to FIG. 3D. As shown, the top profile is wave like, and this is because only the mask patterns (24a), which is formed on top of the dummy gates (22 and 23), are polished away preserving the total height of each dummy gate (22 and 23) identical.

Claim 1 has been amended to clearly recite this feature of the claimed invention:

performing a non-linear planarization by performing chemical mechanical polishing (CMP) process to polish away the insulating interlayer formed above the mask patterns and the mask patterns, exposing the patterned dummy gate polysilicon layer of each dummy gate,

wherein a slurry having a selection ratio of over 20 between the insulating interlayer and the dummy gate polysilicon layer is used for the CMP process,

wherein the length of each dummy gate formed on the semiconductor substrate and the length of each dummy gate formed on the field oxide are identical, and

wherein the surface of the polished dummy gate and the insulating layer is wave-like due to the height difference between the dummy gates formed on the field oxides and those formed on the semiconductor substrate;

It is again asserted that (1) APA teaches that a conventional CMP process that

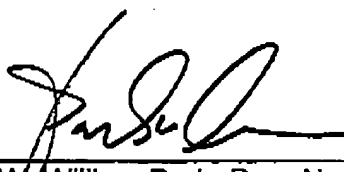
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completely planarizes a surface; (2) Maniar teaches CeO<sub>2</sub> as being a conventional slurry material used in a CMP process and Applicants admit this; (3) Maniar teaches a conventional CMP process of linear planarization and teaches away from the non-linear planarization; and therefore (3) there is nothing in APA and Maniar about the non-linear planarization. APA teaches a conventional CMP process that completely planarizes a surface, even if the known conventional CeO<sub>2</sub> based slurry of Maniar is used.

For the reasons set forth above, Applicants respectfully submit that Claims 1-3, 5-6, and 8-9, pending in this application, are in condition for allowance over the cited references. This amendment is considered to be responsive to all points raised in the Office Action. Accordingly, Applicants respectfully request reconsideration and withdrawal of the outstanding rejections and earnestly solicit an indication of allowable subject matter. Should the Examiner have any remaining questions or concerns, the Examiner is encouraged to contact the undersigned attorney by telephone to expeditiously resolve such concerns.

Respectfully submitted,



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